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Neuropsychological predictors of quality of life in focal epilepsy

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ABSTRACT

Spontaneous complaints of outpatients with focal epilepsy often stress the relationship between cognitive deficits and Quality of Life (QOL). Consequently, the aim of the present study was to find the best neuropsychological predictors of QOL in individuals with focal epilepsy, in order to guide their ambulatory health care.

A sample of 71 Portuguese patients was studied: 40 female, 47 married, with a mean age of 37.48 years (S.D. = 11.79, 16–62), mean education of 7.93 (S.D. = 4.05, 3–17), and focal epilepsy of moderate severity. A Socio-demographic and Clinical Questionnaire, the SF-36 v1, the Cognitive Functioning Scale from the ESI-55, a Seizure Control scale (items from the Liverpool Seizure Severity Scale), and several neuropsychological tests were used.

Semantic Fluency was the only predictor of Physical Functioning, Role Functioning – Physical, and Mental Health; I.A. Test predicted Bodily Pain; and Attentive Matrices predicted General Health, Vitality, and Role Functioning – Emotional. The Mental Component of the SF-36 v1 was predicted by Attentive Matrices, and the Physical Component was predicted by Semantic Fluency. Cognitive Functioning was predicted by the Token Test. Social Functioning and Seizure Control presented no statistically significant correlation with the neuropsychological indicators used.

These results underscore the importance of cognitive performance to the QOL of individuals with focal epilepsy, supporting the systematic screening of cognitive performance in this population. Additionally, they suggest cognitive rehabilitation has the potential to improve these individuals' QOL.

1. Introduction

According to the World Health Organization, Quality of Life (QOL) is "an individual's perception of their position in life in the context of the culture and value system in which they live and in relation to their goals, expectations, standards, and concerns. It is a broad-ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, and relationship to salient features of their environment".[1(p99)]

In fact, clinical practice and research findings have been indicating that it is necessary to use a broad framework to encompass the variety of factors that can affect the QOL of individuals with Epilepsy (e.g., Refs. 2–5). This idea is perfectly straightforward if one considers the number of QOL domains that can be relevant for individuals with Epilepsy.[3,6–11] Still, it is not clear to which point different factors contribute to the QOL of individuals with Epilepsy and the reasons for the significant variations between them.[12]

There is now considerable evidence of the differences (and similarities) between epilepsy patients and healthy subjects (e.g., Refs. 13–15). Several studies have also focused on the relationship between QOL and different socio-demographic and clinical variables (e.g., Refs. 13–16). Additionally, the QOL of epilepsy patients has been compared with the QOL of patients with other chronic disorders.[17]

Bishop and Allen[18] identified ten categories or domains of QOL in a community-based sample of adults with epilepsy. Moreover, twelve categories of factors were identified as improving QOL; and thirteen categories of factors were seen as reducing QOL – one of the most frequently identified factors being cognitive limitations. Biological, psychological and social factors were identified. Epilepsy was seen as having both a direct and an indirect impact on QOL, by directly affecting QOL domains and by affecting those factors that contribute to QOL.

In this context, when research points out a role for socio-demographic, biological/clinical, psychological, and social variables in the QOL of epilepsy patients, it seems reasonable to

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explore more profoundly the relationship between QOL and factors that can be changed. Depression, anxiety and cognitive functioning are examples of such factors (cf., e.g., Refs. 19–30). Nevertheless, results are not always consistent regarding the first two factors (e.g., Refs. 31–37).

Furthermore, it is not rare to find that independent relationships between QOL and socio-demographic or clinical epilepsy variables is limited and that some of these variables are not significant predictors of QOL (e.g., Refs. 31,37).

In 1999, Perrine and Kiolbasa[10] emphasized the complex interaction between cognitive deficits, humour disturbances and QOL, defending that the relationship between them should be assessed when one is treating Epilepsy patients. In this context it is worth stressing that: (a) in many individuals with Epilepsy QOL is more negatively affected by treatment side-effects than by the seizures themselves; and that (b) both the Epilepsy and its treatment can negatively affect cognition.[38]

Similarly, Austin et al.[39] suggested that the neurological condition inherent to Epilepsy (/and antiepileptic drugs) has a negative impact over cognitive function that can: (a) directly affect academic performance and (b) reduce the individuals' ability to adequately adapt to seizures. Consequently, they emphasized the need to investigate cognitive functioning, coping strategies and QOL.

Engelberts et al.[40] studied adult outpatients with relatively well-controlled partial epilepsy without symptomatic aetiology, who were on carbamazepine monotherapy and matched healthy controls. Patients had no difficulty with the immediate recall of newly presented information, nor with semantic fluency, and their learning capacity was not limited. Still, patients not only stored less information in long-term memory, but also could not easily retrieve this information later. Additionally, their attention and speed of information processing was lower. Self-perceived cognitive functioning was lower than in healthy controls. QOL was significantly lower on domains concerned with mental functioning in patients (vs. controls). There was no clinical factor (age at onset, duration of epilepsy, seizure type, seizure frequency, localization, years on carbamazepine, and dosage) that could contribute significantly to QOL or cognitive functioning.

In Liou et al.[13] study, epilepsy patients often had difficulty in thinking, learning, memory and concentration (Psychological domain), and in Loring et al.[32] study, Cognitive Difficulty was a QOL predictor.

The recognition of the importance of cognitive performance to QOL led to the construction of QOL instruments that cover this domain (e.g., ESI-55, QOLIEs). Vickrey et al.,[41] for instance, reported that the Cognitive Function Scale from the ESI-55 (self-perception of functioning) correlated with Emotional Well-Being and General QOL in individuals with Epilepsy. Nevertheless, Wilson and Goetz,[42] recognizing the importance of the subjective assessment of cognitive functioning in QOL assessment, maintained that such assessment may be influenced by external factors (e.g., depression). Consequently, they also suggested the consideration of a direct measure of cognitive performance.

Hermann[43] even supported that any QOL model that does not include the area of cognitive functioning is incomplete. Defending that neuropsychological and QOL assessments, being complementary, are not synonyms, he sustains their integration.

Leidy et al.[44] were the first to assess the performance of a QOL measure in light of the memory deficit. Those individuals with memory deficits had significantly worse QOL than the ones without memory deficits; there were no differences between the groups in the Mental Health domain only.

The results from Perrine et al.[45] suggested that some cognitive variables seem to be more strongly related to QOL than others. Neuropsychological tests and self-reports of cognitive functioning were significant predictors of Global QOL; humour was a strong moderating variable explaining much of the impact of cognitive functioning over QOL.[45]

Breier et al.[46] showed a significant relationship between cognitive performance and cognitive functioning perception (QOL domain), independent of depression. Similarly, Giovagnoli and Avanzini[47] found that QOL was significantly associated with humour and memory: both the objective memory deficit and the perception of deficit affected the QOL of the sample. They also found that memory perception was associated with humour, memory tests, age, seizure frequency, lesion status, and Epilepsy localization.

On the other hand, Mihara et al.[48] compared memory self-assessment with neuropsychological assessment in individuals submitted to Temporal Lobe Epilepsy surgery, finding no correlation.

It is worth stressing that the data already gathered concerning the factors associated with/that contribute to the QOL of epilepsy patients have been used to assess treatment strategies and to develop new intervention efforts (e.g., Refs. 49–53).

In sum, research on the contributors of epilepsy patients' QOL can have a considerable impact on the health care offered to them (cf. Refs. 54–56). Nevertheless, there is a paucity of published work analysing cognitive rehabilitation as a way to improve adult epilepsy patients QOL (e.g., Ref. 57). In this context, the aim of the present study is to analyse the predicting role of some cognitive performance indicators on the QOL of a group of Portuguese adults with focal epilepsy.

2. Materials and methods

2.1. Participants

A consecutive sample of 71 Portuguese epilepsy patients was studied. To be considered for the study, patients had to have 16 or more years but less than 66 years of age (cf. cerebral maturation), clinical evidence of focal epilepsy (temporal or frontal) according to their neurologist, but no evidence of communication or psychiatric disorder that could limit the administration of the battery.

Taken these criteria into account, the neurologists of the Unit selected a total of 100 outpatients during a 3-year period (cf. funding for a PhD research project). The selection was based on outpatient records reviewed weakly or on EEG request forms reviewed daily. Further investigation (e.g., EEG report) showed that, among those patients selected based on EEG request forms (methodology considered in order to speed up the selection process), 25 did not fulfilled the inclusion criteria presented earlier (namely, did not have focal epilepsy). Of the remaining 75, 4 did not undergo neuropsychological assessment due to their personal time constraints.

The final sample's socio-demographic and clinical characterization is shown in Tables 1 and 2, respectively. The analysis of both tables indicates that the majority of participants were female and married/cohabiting, with a mean age 37.48 years, mean education of 7.93 years, and focal epilepsy of moderate severity.

It is also worth mentioning that Epilepsy Onset took place between .25 and 46.0 years before assessment ($M = 16.84$, S.D. = 11.13), when participants had a mean age of 20.65 years (S.D. = 12.91, 1–57).

2.2. Materials and procedure

A Socio-demographic and Clinical Questionnaire was developed to characterize the sample. For precaution (cf. Ref. 58), the questionnaire had a mixed structure: items to be completed

Table 1
Socio-demographic characteristics of the sample.

Socio-demographic variables	Number of cases (%) (*N* = 71)
Gender	
Females	40 (56.3%)
Males	31 (43.7%)
Mean age (S.D.) (Amplitude) (years)	37.48 (11.79) (16–62)
Mean education (S.D.) (Amplitude) (years)	7.93 (4.05) (3–17)
Marital status	
Married/cohabiting	47 (66.2%)
Single	21 (29.6%)
Widow	2 (2.8%)
Separate/divorced	1 (1.4%)
Occupation	
Employed	49 (69.0%)
Unemployed	2 (2.8%)
Students	10 (14.1%)
Retired	10 (14.1%)
Laterality	
Right-handed	63 (88.7%)
Left-handed	5 (7.0%)
Ambidextrous	3 (4.2%)

Table 2
Clinical characteristics of the sample.

Clinical Variables	Number of cases (%)[a]	Valid cases
Pharmacological therapy		71
Without medication	4 (5.6%)	
Monotherapy	36 (50.7%)	
Two medications	22 (31.0%)	
More than two medications	9 (12.7%)	
Medication side-effects		67
Without	55 (77.5%)	
With	12 (16.9%)	
Single type of seizures	49 (69.0%)	71
Only simple partial	2 (2.8%)	
Only complex partial	21 (29.6%)	
Only secondarily generalized partial	7 (9.9%)	
Only generalized tonic clonic	19 (26.8%)	
Seizure frequency		71
Daily	3 (4.2%)	
More than one/week	5 (7.0%)	
One or less/week	2 (2.8%)	
More than one/month	15 (21.1%)	
One or less/month	9 (12.7%)	
More than one/year	6 (8.5%)	
One or less/year	15 (21.1%)	
Without seizures for three or more years	9 (12.7%)	
Unknown	7 (9.9%)	
Epileptogenic focus localization		71
Temporal	47 (66.2%)	
Frontal	13 (18.3%)	
Frontotemporal	9 (12.7%)	
Frontoparietal	2 (2.8%)	
Focus lateralization		71
Left hemisphere	36 (50.7%)	
Right	19 (26.8%)	
Bilateral	4 (5.6%)	
Not precise	12 (16.9%)	
With other diseases	20 (28.2%)	71
Other medications associated	12 (16.9%)	71

[a] The percentages always refer to the total sample (*N* = 71), even though there are missing cases in some items, due, for instance, to their inadequacy for some participants. In these cases, the number of individuals that "answered" is shown in the third column.

through an interview with the participant and items to be completed through the analysis of his/her clinical records. Due to protocol length, and the limitations of preference inventories and mastery measures, a standardized laterality measure was not used. Instead, the items 1 (write), 6 and 7 (eat) from the Edinburgh Handedness Inventory were used, which correspond to items 1 and 9 from the Test for Handedness and to item 1 from Handedness Research.[59] They, roughly, allowed the determination of the participants' laterality. Based on the Handedness Research, participants were also asked if there was any activity they performed with the other hand.[59] Additionally, the item covering medication side-effects is a short version of the neurological examination undertaken in the assessment of the QOLIE-based in neurotoxicity and systemic toxicity scales.[60] Finally, it is worth mentioning that data concerning seizure type and frequency was gathered through the analysis of patients' clinical records.

QOL was measured using the Portuguese version of the SF-36 v1.0,[61] complemented by nine epilepsy specific items, covering Cognitive Functioning (Cognitive Functioning Scale from the ESI-55, i.e., items 35, 36, 38, 49, and 50[62]), and Seizure Control (items 2, 3, 4, and 5 from the Control Perception subscale of the Liverpool Seizure Severity Scale – LSSS[7,63–65]), in a total of 11 scores (SF-36: Physical Functioning, Role Functioning – Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role Functioning – Emotional, and Mental Health scale scores (0–100; a higher score indicates better QOL), Mental and Physical Component scores (0–100; a higher score indicates better QOL), and Reported Health Transition score (single item; "much better now than one year ago" to "much worse now than one year ago"); Cognitive Functioning score (0–100; a higher score indicates better QOL); and Seizure Control score (4–16; a higher score indicates worse QOL)).

Several neuropsychological tests were also used: Logical Memory (only the A version; immediate and 3′ delayed recall[66]), Attentive Matrices,[67] Rey Complex Figure (immediate and 3′ delayed recall[68]), Semantic Fluency,[69] Wisconsin Card Sorting Test (Nelson's version–WCSTNv[70]), Token Test,[71] Digit Span,[66] Corsi Span,[67] and I.A. Test (similar to the Raven Matrices[72]).

The following neuropsychological test scores were used: Logical Memory I and II – total score (0–24; a higher score indicates better performance); Attentive Matrices – correct answers (0–60; a higher score indicates better performance); Rey Complex Figure I and II – points (0–36; a higher score indicates better performance); Semantic Fluency – total score (no limit; a higher scores indicates better performance); WCSTNv – categories (0–6; a higher scores indicates better performance), errors (no limit), divided into perseverative errors and non-perseverative errors, and percentage of perseverative errors; Token Test – total score (0–22; a higher scores indicates better performance); Digit Span – total score (3–9; a higher scores indicates better performance); Corsi Span – total score (2–10; a higher score indicates better performance), and I.A. Test (0–30; a higher score indicates better performance).

The decision making process regarding the methods to assess QOL and cognition involved: literature review on the cognitive functions usually impaired in temporal and frontal lobe epilepsy; literature review on neuropsychological tests usually administered to assess such functions not only but also to (focal) epilepsy patients; literature review on the QOL instruments usually administered to (focal) epilepsy patients; literature review and consultation with experts (from the North, Centre, and South regions of the country) to identify which of the previously listed instruments had European Portuguese versions; literature review on the psychometric characteristics of the instruments (and, when appropriate, the different versions of each); literature review and expert consultation on protocol length, burden, and clarity/simplicity; finally, the simplicity and time needed to administer,

score, and interpret each instrument's scores was taken into account as there was only a psychologist responsible for all the assessments (RFM). The criteria supporting the choice of each instrument used are thoroughly presented in Meneses.[5]

The psychometric characteristics of the instruments used (considering internal consistency – Cronbach α; content validity – instruments' selection process; construct validity – sensitivity to co-morbidity and non-AED medication/principal components analysis, Varimax rotation, Kaiser normalization of the neuropsychological battery) were acceptable to good.

The standardized instructions (/a Portuguese translation) and scoring guidelines were followed. All instruments were administered in the context of an individual interview by the first author, with training in the assessment procedures.

Internationally accepted ethical principles were followed. Consequently, the proper institutional approval was obtained and the study has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans[73] and the Ethical Principles of Psychologists and Code of Conduct of the American Psychological Association.[74]

With the Statistical Package for the Social Sciences (SPSS) 15.0, descriptive analysis of the sample were done using the mean, standard deviation, amplitude, frequencies (and percentages); Pearson correlations (2-tailed) were calculated to explore the association between QOL and neuropsychological scores; regression analysis – Linear Regression, Method Stepwise – was used to find the neuropsychological predictors of QOL, according to Pestana and Gageiro.[75]

In more detail, to achieve the aim of the study, first the correlation between the cognitive performance indicators (predictors or independent variables) and the QOL measures (predicted or dependent variable) was inspected, followed by the inspection of the joint contribution of the predictor variables on QOL. Regression analysis is applied to a data set in which the predictor variables are correlated with one another and with the predicted variable to varying degrees, and to determine the importance of each of the predictors for the relationship.

It was considered that a rule of thumb and generally accepted arbitrary statistical power value is .80 ($1 - \beta = .80$). A sample size necessary for a correlation of $r = .30$ with a confidence level of 95% needs to include at least 67 subjects.

3. Results

Tables 3 and 4 show the mean, standard deviation, and amplitude of the scores obtained by the participants on the QOL and neuropsychological indicators, respectively. The variability of the scores is the most prominent finding.

As far as the Reported Health Transition (SF-36) is concerned (''Compared to one year ago, how would you rate your health in general now?''), 22.5% of participants reported they were ''much better now than one year ago'', 21.1% reported they were ''somewhat better now than one year ago'', 47.9% reported they were ''about the same as one year ago'', and 8.5% reported they were ''somewhat worse now than one year ago''. No one reported being much worse.

Table 5 shows the Pearson correlations between the QOL and neuropsychological scores of the sample. Social Functioning and Seizure Control were the only QOL indicators that presented no statistically significant correlation with the neuropsychological indicators used.

Considering the statistical power described before, the correlation values for the Physical Component of SF-36 with Attentive Matrices, Semantic Fluency, and I.A. test reject the null hypotheses and the effect found probability exists. The same is true for the relationship between Mental Component of SF-36 and the results of Attentive Matrices. Other results of correlation are above the $1 - \beta = .80$, namely for General Health, Vitality and Mental Health.

Table 3
Quality of life scores.

QOL indicators	*M*	S.D.	Amplitude	Valid cases
SF-36 v1				71
Physical Functioning	87.81	15.96	35–100	
Role Functioning – Physical	75.00	35.10	0–100	
Bodily Pain	68.53	29.88	0–100	
General Health	53.42	19.27	20–92	
Vitality	54.57	25.42	0–100	
Social Functioning	82.21	23.01	0–100	
Role Functioning – Emotional	69.01	38.76	0–100	
Mental Health	58.08	23.53	4–100	
Mental Component	65.97	22.71	11.33–98.75	
Physical Component	71.19	19.09	28.00–98.00	
Cognitive Functioning (ESI-55)	60.31	23.76	4–100	71
Seizure Control (LSSS)	10.60	3.68	5–16	45

Considering the correlations between the different WCSTNv indicators, only the number of categories achieved was used for the regression analysis (Linear Regression, Method Stepwise). For the regression analysis the QOL scores were used as dependent variables and the neuropsychological scores as independent variables.

Semantic Fluency was the only predictor of Physical Functioning ($R^2_a = .07$, $p = .01$), Role Functioning – Physical ($R^2_a = .08$, $p = .007$), and Mental Health ($R^2_a = .09$, $p = .005$); I.A. Test predicted Bodily Pain ($R^2_a = .07$, $p = .01$); and Attentive Matrices predicted General Health ($R^2_a = .20$, $p = .000$), Vitality ($R^2_a = .09$, $p = .006$), and Role Functioning – Emotional ($R^2_a = .06$, $p = .01$). The Mental Component of the SF-36 v1 was predicted by Attentive Matrices ($R^2_a = .09$, $p = .006$), and the Physical Component was predicted by Semantic Fluency ($R^2_a = .16$, $p = .000$). Cognitive Functioning was predicted by the Token Test ($R^2_a = .05$, $p = .03$).

Consequently, in the present sample the neuropsychological indicators explain little of the QOL variance, except for General Health and Physical Component.

4. Discussion

Language (Semantic Fluency and Token Test performance), General Intelligence (I.A. Test performance), and Attention (Attentive Matrices performance) were the best neuropsychological predictors of the sample's QOL. Consequently, these preliminary results support

Table 4
Neuropsychological scores.

Neuropsychological indicators	*M*	S.D.	Amplitude	Valid cases
Logical Memory I	8.21	3.93	1–18	71
Logical Memory II	12.19	4.83	3–23	69
Attentive Matrices (correct)	49.17	9.24	18–59	71
Rey Complex Figure I (points)	31.10	4.15	16–36	65
Rey Complex Figure II (points)	16.46	6.46	1–32	64
Semantic Fluency	35.39	10.72	14–62	71
WCSTNv[a] Categories	3.77	1.91	0–6	71
WCSTNv Errors	17.72	10.75	1–42	71
WCSTNv Perseverative Errors	6.42	8.01	0–42	71
WCSTNv Non-perseverative Errors	11.30	6.91	0–27	71
WCSTNv % of Perseverative Errors	30.75	21.29	0–100	71
Token Test	19.15	2.97	9.5–22	67[b]
Digit Span	5.46	1.32	3–9	71
Corsi Span	4.73	0.91	3–7	71
I.A. Test	13.31	5.60	3–26	68

[a] WCSTNv-Wisconsin Card Sorting Test Nelson's version.
[b] The majority of missing cases was due to an inability to distinguish circles from squares.

Table 5
Pearson correlations (2-tailed) between the quality of life and neuropsychological scores.

		LM[a] 1	AM	LM 2	RCF 1	SF	RCF 2	WCST cat	WCST e	WCST npe	WCST pe	WCST % pe	TT	DS	CS	IA
PF	*r*	−.01	.17	.03	.16	**.25**	.21	.14	−.13	−.10	−.09	−.00	.04	.00	.15	**.27**
	p	.88	.13	.80	.18	**.03**	.08	.23	.27	.40	.45	.96	.73	.96	.20	**.02**
	N	71	71	69	65	**71**	64	71	71	71	71	71	67	71	71	**68**
RFP	*r*	.15	.20	.20	.10	**.31**	.13	.09	−.11	−.10	−.06	−.03	.07	.10	.07	.19
	p	.21	.09	.08	.42	**.00**	.27	.42	.32	.37	.57	.77	.54	.40	.51	.11
	N	71	71	69	65	**71**	64	71	71	71	71	71	67	71	71	68
BP	*r*	.10	**.27**	.17	.11	**.27**	.18	**.29**	**−.29**	**−.24**	−.18	−.04	−.00	.10	.15	**.29**
	p	.36	**.02**	.15	.36	**.02**	.14	**.01**	**.01**	**.04**	.12	.68	.95	.39	.20	**.01**
	N	71	**71**	69	65	**71**	64	**71**	**71**	**71**	71	71	67	71	71	**68**
GH	*r*	.04	**.46**	.14	.16	**.34**	.14	**.31**	**−.26**	−.14	−.23	−.04	.06	.11	.17	**.26**
	p	.72	**.00**	.24	.19	**.00**	.24	**.00**	**.02**	.22	.05	.73	.57	.33	.14	**.03**
	N	71	**71**	69	65	**71**	64	**71**	**71**	71	71	71	67	71	71	**68**
V	*r*	.07	**.32**	.04	.01	**.24**	.01	−.06	.08	.13	−.01	.00	−.02	.08	.16	.14
	p	.53	**.00**	.74	.92	**.04**	.88	.57	.50	.25	.93	.99	.84	.48	.16	.22
	N	71	**71**	69	65	**71**	64	71	71	71	71	71	67	71	71	68
MH	*r*	.19	**.29**	.17	.04	**.32**	.20	.09	−.07	−.00	−.09	−.07	.09	.14	.21	.23
	p	.10	**.01**	.15	.72	**.00**	.10	.42	.51	.93	.41	.53	.45	.21	.07	.05
	N	71	**71**	69	65	**71**	64	71	71	71	71	71	67	71	71	68
RFE	*r*	.09	**.27**	.08	−.00	.20	.01	−.05	.02	.07	−.03	−.05	−.10	.07	.05	.07
	p	.42	**.01**	.50	.96	.08	.91	.67	.86	.54	.76	.66	.40	.55	.62	.55
	N	71	**71**	69	65	71	64	71	71	71	71	71	67	71	71	68
SF	*r*	−.07	.15	−.06	−.16	.06	−.01	−.09	.11	.06	.10	.13	−.09	−.17	.05	−.06
	p	.52	.19	.58	.18	.59	.88	.44	.32	.57	.40	.26	.47	.15	.62	.62
	N	71	71	69	65	71	64	71	71	71	71	71	67	71	71	68
MC	*r*	.09	**.32**	.07	−.02	**.25**	.05	−.03	.04	.08	−.01	−.00	−.05	.04	.14	.11
	p	.43	**.00**	.54	.81	**.03**	.64	.74	.73	.48	.88	.95	.69	.68	.23	.34
	N	71	**71**	69	65	**71**	64	71	71	71	71	71	67	71	71	68
PC	*r*	.11	**.35**	.20	.16	**.39**	.21	**.26**	**−.26**	−.20	−.18	−.04	.05	.11	.17	**.32**
	p	.32	**.00**	.09	.18	**.00**	.08	**.02**	**.02**	.09	.13	.70	.64	.33	.15	**.00**
	N	71	**71**	69	65	**71**	64	**71**	**71**	71	71	71	67	71	71	**68**
SC	*r*	−.13	−.15	−.10	.15	−.10	−.18	.12	−.16	−.12	−.11	.05	−.11	−.01	.08	−.03
	p	.36	.31	.52	.32	.47	.25	.39	.28	.42	.45	.71	.48	.90	.56	.80
	N	45	45	43	41	45	40	45	45	45	45	45	43	45	45	43
CF	*r*	.15	.10	.01	−.21	.15	−.06	−.10	.11	.13	.04	.07	**−.25**	−.08	−.03	−.18
	p	.20	.40	.93	.09	.18	.63	.37	.32	.26	.73	.54	**.03**	.50	.75	.13
	N	71	71	69	65	71	64	71	71	71	71	71	**67**	71	71	68

Bold numbers represent statistically significant correlations.

[a] PF: Physical Functioning; RFP: Role Functioning Physical; BP: Bodily Pain; GH: General Health; V: Vitality; MH: Mental Health; RFE: Role Functioning Emotional; SF: Social Functioning; MC–Mental Component; PC: Physical Component; SC: Seizure Control; CF: Cognitive Functioning; LM: Logical Memory; AM: Attentive Matrices; RCF: Rey Complex Figure; SF: Semantic Fluency; WCST cat: Wisconsin Card Sorting Test categories; WCST e: WCST errors; WCST npe: WCST non-perseverative errors; WCST pe: WCST perseverative errors; WCST % pe: WCST percentage of perseverative errors; TT: Token Test; DS: Digit Span; CS: Corsi Span; IA: I.A. Test.

a role for cognitive performance in the QOL of individuals with focal epilepsy of moderate severity. More specifically, Language, General Intelligence, and Attention may be particularly important. Unfortunately, the absence of Portuguese normative values makes it impossible to know if the neuropsychological performance exhibited by patients was out of the normal range. That is, it is unknown if the predicting value of the neuropsychological tests used reflects the awareness of certain cognitive deficits. Regrettably, this state of affairs is not rare in the literature, even when there is a careful choice of instruments (cf., e.g., Ref. 76).

Consequently, the results suggest the importance of systematically screening for cognitive performance in individuals with focal epilepsy. They also suggest the need of correct focus identification, even when Epilepsy is of moderate severity, and, in the absence of normative values, the need to compare the scores obtained with those of matched controls. Additionally, they suggest cognitive rehabilitation (namely, of attention) has the potential to improve these individuals' QOL. This hypothesis must be tested after guaranteeing that patients do have cognitive deficits.

Other aspects are also worth mentioning. The first has to do with the considerable variability in the QOL and neuropsychological scores of the sample. Of course that this can be a mere reflection of the age and educational diversity of the sample, but it can also mean that individuals with focal epilepsy of moderate severity do not constitute a homogeneous group. This has significant clinical implications, namely if one considers promoting patients QOL and/or cognitive rehabilitation.

There were several statistically significant correlations, of low to moderate intensity, between QOL and neuropsychological indicators, similar to those of Giovagnoli and Avanzini.[47] These correlations underscore that some QOL dimensions are more intimately related with cognitive performance than others (cf. Ref. 45). Devinsky et al.[60] had similar results.

As could be expected, Physical Functioning and Role Functioning – Physical correlated with few neuropsychological scores: with those that were consistently related to the physical domain (I.A. Test) and/or with most QOL scores (Semantic Fluency). If one considers that Bodily Pain, Vitality, and General Health are intimately related domains, a similar pattern of relationships between these indicators and neuropsychological scores is to be expected. It makes sense that the recent experience of pain, generally independent of epilepsy, has a negative impact over the

perception of general health and vitality. Additionally, if one considers the potentially negative effect of pain on attention and motivation – central to a good neuropsychological performance – the relationship between pain and several neuropsychological scores, which has been reported in the literature, is understandable (e.g., Ref. 77). The statistically significant correlation found by Perrine et al.[45] between the language factor and Energy/Fatigue can be considered similar to the relationship between Semantic Fluency and Vitality found in the present study.

The relationship between Mental Health and neuropsychological performance is widely recognized (cf., e.g., Ref. 78). Even so, Leidy et al.[44] found that individuals with memory deficits had statistically worse QOL scores than individuals without deficits, except in the Mental Health domain (no statistically significant differences were found). Additionally, the association between Role Functioning – Emotional and performance on the Attentive Matrices is to be expected if one considers item 5c (careful performance).

Even though the complexity of the relationship between cognitive complaints and performance is unarguable (e.g., Ref. 79), the exclusive relationship between Cognitive Functioning and performance on the Token Test is unexpected and deserves future exploration. Maybe it is due to the fact that performance perception reflects conditions other than cognitive difficulties (e.g., depression, other subjective factors).[47,79] It is also possible that different types of complaints related to a specific function are differentially associated to different "objective" tests of that function.[79] Therefore, the Cognitive Functioning Scale may not be the most adequate to screen for deficits assessed by the tests chosen, or vice-versa. In fact, with different instruments, Devinsky et al.[60] and Perrine et al.,[45] for instance, obtained statistically significant correlations between cognitive functioning perception (attention/concentration, memory and language) and performance on neuropsychological tests of the same functions. Inversely, Mihara et al.[48] and Perrine et al.[45] found that some results of neuropsychological testing (e.g., with the RCF) had no statistically significant correlations with QOL/performance perception scales (cf. Social Functioning in the present study). It is also worth remembering that Breier et al.[46] only found statistically significant correlations between the QOLIE Language scale and the neuropsychological test for language in individuals with left partial seizures. Since the majority of participants of the present study had a left focus this may have had a certain influence on the relationship found between Cognitive Functioning and the Token Test score (a language test). Be as it may, the present results indicate, once more, that there is no simple relationship between "objective" performance and "subjective" perception in Epilepsy patients.

In sum, the present results support Hermann's[43] point of view – any QOL model that does not include Cognitive Functioning is incomplete – and that of Wilson and Goetz[42] – "objective" and "subjective" assessments of cognition should be performed in QOL research.

In terms of future research, namely in Portugal, the present results highlight the need to clarify the relationship between gender, age, schooling/literacy and cognitive performance, and not only in epilepsy patients, since the international literature has contradictory data. Portuguese norms, considering such relationships, will allow the detection of deficit and strength patterns that can be the basis for cognitive rehabilitation programs. It will also allow us to verify if memory is, in fact, one of the most affected functions. Obviously, the establishment of Portuguese norms calls for a deeper knowledge about the instruments (e.g., psychometric properties, relationships between instruments). Additionally, it is essential to investigate what is behind every cognitive complaint, i.e., cognitive factors or other type of factors.

Considering the relationships found, it makes sense to assume that changing cognitive performance (by means of cognitive rehabilitation) can lead to (direct or indirect) changes in QOL perception. In this context, the results of the present study suggest that different cognitive functions may be rehabilitation targets in order to promote certain QOL domains: rehabilitating attention (cf. Attentive Matrices) might have an impact on Bodily Pain, General Health, Vitality, Mental Health and Role Functioning–Emotional (and SF-36 Mental and Physical Components); rehabilitating language (cf. Semantic Fluency and Token Test) might have an impact on every QOL domain studied, except Role Functioning – Emotional, Social Functioning (Cognitive Functioning) and Seizure Control; rehabilitating executive functions (cf. WCST) might have an impact on Bodily Pain and General Health (and Physical Component); rehabilitating general intelligence (cf. I.A. Test) might have an impact on Physical Functioning, Bodily Pain, and General Health (and Physical Component).

The opposite possibility can also be raised: can QOL promotion enhance cognitive functioning? Regression analysis, even though unable to deny this possibility, suggests that it is the other way around. Since the predicting value of the neuropsychological indicators was not very high, the search for other predictors of QOL seems urgent in order to promote these patients QOL.

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